

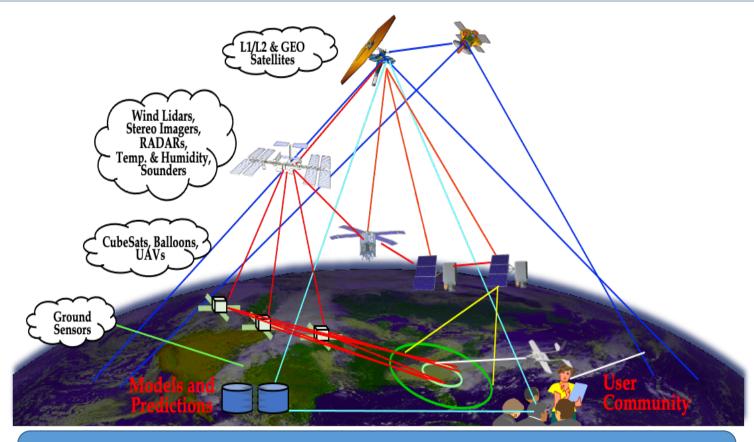
## Historical Flood Demonstration: A Proof-of-Concept for New Observing Strategies, Technologies, and the NOS Testbed

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# **New Observing Strategies**





Novel Observing Concept Design Timely Adaptive Capture of Science Events Actively acquire data in coordination with other sensors and models in response to measurement needs and/or science events

Increase understanding and predictability of dynamic events on Earth

Provide a more Complete
Picture of Earth System
Processes

# **New Observing Strategies Testbed**



#### The NOS Testbed is a software environment for:

- Validating observing system concepts and technologies
- Demonstrating new observing strategies
- Trade studies, Evaluation, and Socialization

### A First Use Case



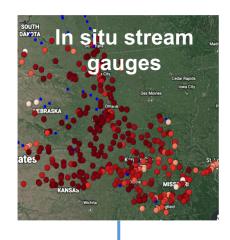
- Demonstrate a New Observing Strategy that Coordinates in situ sensors, remote sensing, and models to better observe a flood.
- Demonstrate the concept running in the NOS testbed as proof-of-feasibility
- Observations are simulated with historical data from the Midwest flood of 2019. Scenario focuses on the few days near the peak flood.
- This is a first 'proof-of-feasibility' for the testbed.
   Other scenarios may be considered in the future.

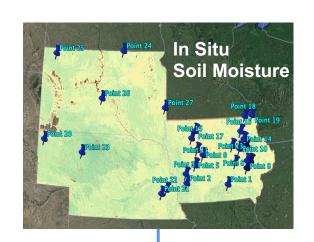


Credit: Air Force

# New Observing Strategy for Flood Scenario

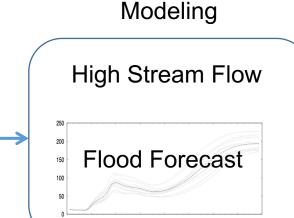












#### Trigger Analysis

Expedited flood product requests

Observation requests

#### Retasking

Schedule observations taking into account observability and availability constraints

Image credits Skysat: Planet Labs NPP: NASA

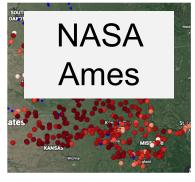
# **New Observing Strategy Elements**



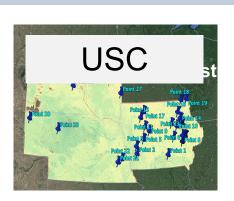
- Flood scenario is an example of how satellite and in situ sensors can be directed to acquire high value observations of predicted events.
- Retasks commercial satellites to acquire higher-resolution (space and time) images of predicted high-utility flood regions, while flood peaks are occurring.
- Requests low-latency VIIRS product for assimilation when floods are likely (via AWS Ground Station as a Service and Stream Gage triggers)
- Upscaled in-situ sensors provide soil moisture data with larger spatial coverage.

# Simulated in NOS Testbed









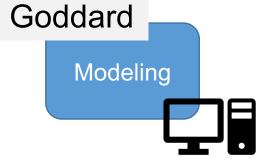


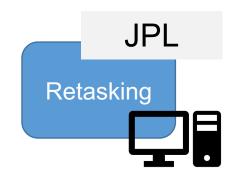


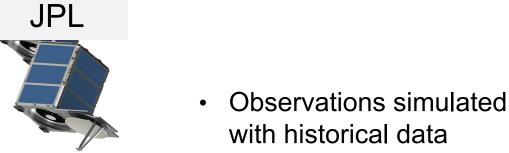








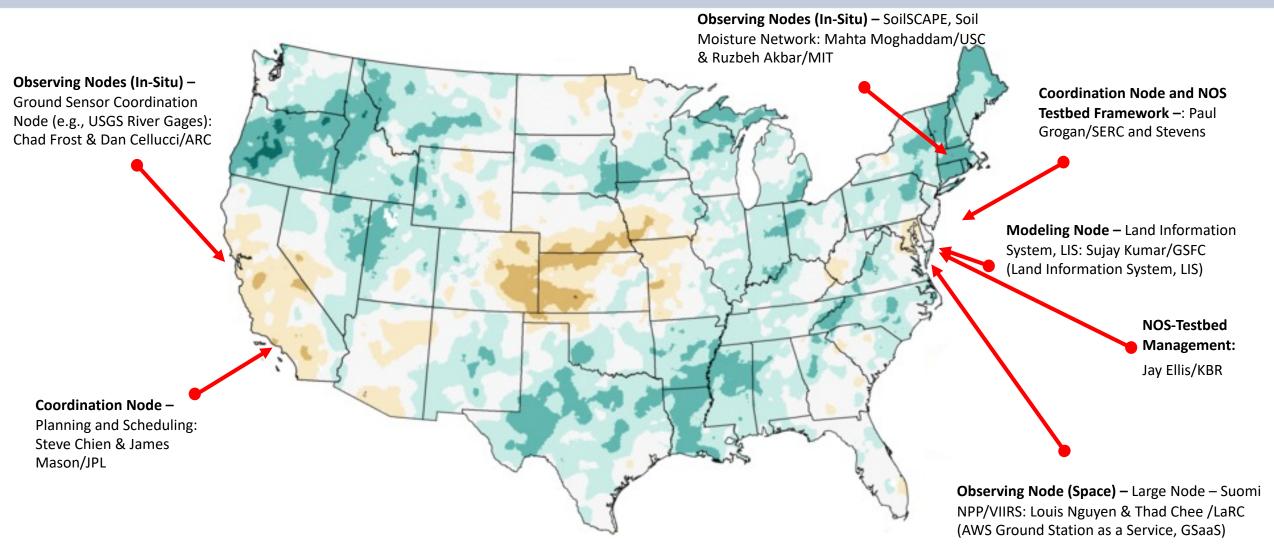




- Nodes run on distributed servers
- Communicate via a Publish-Subscribe message broker.

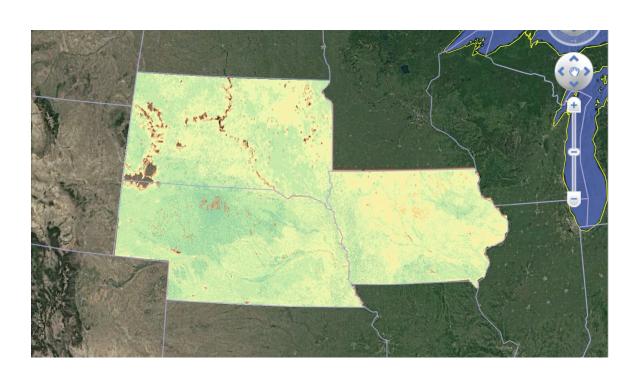
### **Testbed Nodes**





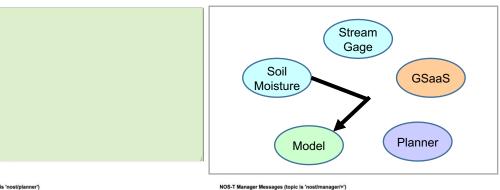
## **Upscaled In Situ Soil Moisture**





Generate upscaled soil-moisture product from in-situ network

#### Simulation Time: 2019-03-15 06:00Z



### Retasking Messages (topic is 'nost/planner') 2021/31/12:5.5.843 ('message': 'new\_trigger', "flepath': 'fliedrop/run/2019031900/trigger\_201903190000.nc') 2021/31/12:4.3277 ('message': 'new\_trigger', "fllepath': 'fliedrop/run/2019031800/trigger\_201903180000.nc') 2021/31/12:3:11:125 ('message': 'new\_trigger', "fllepath': 'fliedrop/run/2019031700/trigger\_201903170000.nc') 2021/31/12:3:13.55 ('message': 'new\_trigger', "fllepath': 'fliedrop/run/2019031600/trigger\_201903160000.nc') Incoming Messages

Forecast (Model) Messages (topic is 'nost/model/#')
2021/3/1 124:53.409 [model] Trigger file generation is complete
2021/3/1 124:53.408 [model] Generating trigger: 11992-1903171800.d01.nc
2021/3/1 124:53.407 [model] Generating trigger: trigger: 201903171200.d01.nc
2021/3/1 124:53.404 [model] Generating trigger: trigger: 2019031710000.d01.nc
2021/3/1 124:53.404 [model] Generating trigger: trigger: 201903170000.d01.nc
2021/3/1 124:53.404 [model] Generating trigger: trigger: 2019031800.d01.nc
2021/3/1 124:53.401 [model] Generating trigger: trigger: 20190318100.d01.nc

NWIS Messages (topic is 'mwis/\*')
incoming Messages

#### NOS-T Manager Messages (topic is 'nost/manager/+') 2021/3/112:53112 ("sakingParameters"; ('simStopTime'; "2019-03-19715:00:00-00:00")} 2021/3/112:5318:300 ("name"; "Manager," description: "Manages simulation state and provides synchronized timin properties"; ("simTime"; "2019-03-19712:00:00+00:00", "time"; "2021-03-15716:05:14.676674+00:00")}

roperties; "; sim Imme": 2019-03-1911;200:00-00:00; "time": 2021-03-15116:05-14-0766174-00:00); "Z013112-03-03-36; "mane": "Manages simulation state and provides synchronized timing.", roperties"; ("simTime": "2019-03-19106:00:00+00:00", "time": "2021-03-15116:04-59.876586+00:00")); "Z1/3/112-449-47" ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.", roperties; "fismTime": "2019-03-1910:00:00-00:00", "time": "2021-03-15116:04-59.87658-00:00")); "Time": "2021-03-15116:04-59.87658-00:00"); "time": "2021-03-15116:04-59.87658-00:00"); "time": "2021-03-15116:04-59.8768-00:00"); "time": "2021-03-1516:04-59.8768-00:00"); "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-00:00", "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-00:00", "time": "2021-03-1516:04-59.808-00:00"); "time": "2021-03-1516:04-59.808-

#### SSaaS VIIRS Messages (topic is 'nost/GSaaS') 2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfullyl

21/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution" 1/12:5:22.862 "S. VIIRS Fire imagery: Detected command SUCCESS. Return Code: 0" 21/3/1 12:5:22.669 "Overlaying fires on image product"

021/3/1 12:5:22.597 "L3: VIÍRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing. 021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."

#### 2021/3/1 12:5:22.291 \*Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution

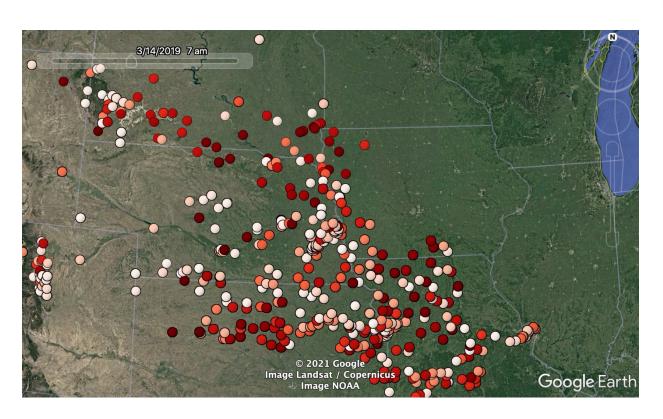
Soil Moisture Messages (topic is 'nost/soilmoisture(+')

#### All Messages As Text (topic is '#')

All messages As Text (loby: is #) rext (loby: is

# In Situ Stream Gage Sensors

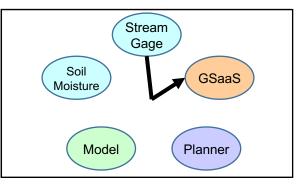




Stream Gauge Data every 6 hours Watch for unusually high flows

#### Simulation Time: 2019-03-15 06:00Z





### Retasking Messages (topic is 'nost/planner') 2021/31/12/5.5.843 ("message": new\_trigger", "flepath": "filedrop/run/20190319001rt/gger\_201903190000.nc") 2021/31/12/5.5.843 ("message": new\_trigger", "flepath": "filedrop/run/20190318000trigger\_201903180000.nc") 2021/31/12/5.11/5.5 ("message": new\_trigger", "flepath": "filedrop/run/20190317000trigger\_201903170000.nc") 2021/31/12/5.11/5.6 ("message": new\_trigger", "flepath": "filedrop/run/20190316000trigger\_201903160000.nc") Incoming Messages

NOS-T Manager Messages (topic is "nost/manager/")

2021/3/1 12-53.11.2 ("tasking"parameters": ("simStop Time": "2019-03-19T15-00.00+00.00"))

2021/3/1 12-53.13.02 ("hasking"parameters": ("simStop Time": "2019-03-19T15-00.00+00.00"))

2021/3/1 12-53.13.02 ("hasme": "Manager", "description": "Manages simulation state and provides synchronized timing.", "properties"; ("simTime": "2019-03-19T16-00-00"))

2021/3/1 12-53.383 ("hane": "Manager," "description": "Manages simulation state and provides synchronized timing.", "properties"; ("simTime": "2019-03-19T06-00-00")

2021/3/1 12-44-4/3/1 ("name": "Manager," "description": "Manages simulation state and provides synchronized timing." ("properties"; "("simTime": "2019-03-19T00-00-00+00")

"time": "2021-03-15T16-04-45.77863+00-00")

# Forecast (Model) Messages (topic is 'nost/model/#') [2021/91 12:453.409 [model] Trigger file generation is complete [2021/91 12:453.409 [model] Compensition (tipger trigger\_201903)71:800.d01.nc [2021/91 12:453.407 [model] Generating trigger; trigger\_201903)71:200.d01.nc [2021/91 12:453.405 [model] Generating trigger; trigger\_201903)71:000.d01.nc [2021/91 12:453.404 [model] Generating trigger; trigger\_201903)71:000.d01.nc [2021/91 12:453.401 [model] Generating trigger; trigger\_201903)71:000.d01.nc [2021/91 12:453.401 [model] Generating trigger; trigger\_201903)71:000.d01.nc

GSaaS VIRS Messages (topic is 'nost/GSaaS')

60213/14 12:5:23:149 "Completed processing of the SDR VIRS algorithm successfully!"

60213/14 12:5:22:2476 "Uploading level 3 fire imagery to Amazon S3 for distribution"

60213/14 12:5:22:268 "Cs. VIRS Fire imagery. Detected command SUCCESS. Return Code: 0"

60213/14 12:5:22:269 "Cvelsiving fires on image product"

60213/14 12:5:22:259 "L3: VIRS Fire imagery: Child job VIRIS Fire imagery started. Processing."

60213/14 12:5:22:47 "All level 2 processing completed. Starting Level 3."

60213/14 12:5:22:241 "Uploading level 2 Flood, Fire and Polse2Coff files to Amazon S3 for distribution"



Soil Moisture Messages (topic is 'nost/soilmoisture/+')
Incoming Messages

All Messages As Text (topic is '#')

2021/3/1 17:3927.563 ['message'' new\_file\_uploaded'']

2021/3/1 17:3927.563 ['message'' new\_file\_uploaded', "flepath': "fles/swe\_output.nc')

2021/3/1 17:338.884 [model]: Received new input, starting processing

2021/3/1 17:337.846 ['message'' new fingen' flepath': "flerophaseline/201903160000,nc')

2021/3/1 17:2417.887 [model]: Received new input, starting processing

2021/3/1 17:2417.887 [model]: Received new input, starting processing

2021/3/1 17:2447.887 [medel]: Received new input, starting processing

2021/3/1 15:28.48.144 ("name" "Socretoard Node", "description": "Displays a visualization of the simulation.", "properties": ("resource": "http://localhost:8050", "subscriptions": ['nost/manageri#', "nost/fround#']", "type": "client"))

## Schedule AWS Ground Station for urgent downlink of VIIRS direct broadcast data

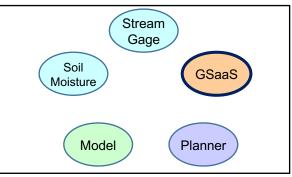




Schedule AWS Ground Station to receive NPP direct broadcast at 17Z

#### Simulation Time: 2019-03-15 12:00Z

2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: http:// 2021/3/5 17:2:59.198 [SOIL] Sending soil moisture KMZ file 2021/3/5 17:2:58.792 [CLOCK]: Received simulation time tid 2021/3/5 17:2:58.117 [NWIS]: Publishing Trigger Data for 20 2021/3/5 17:2:47.727 [CLOCK]: Start of demo simulation. 2021/3/5 17:2:44.961 [SOIL] Soil Moisture system ready. 2021/3/5 17:2:44.823 [SOIL] starting...2 2021/3/5 17:2:44.283 [SOIL] starting...1 2021/3/5 17:2:43.921 [SOIL] starting...0 2021/3/5 17:2:43.427 [SOIL] Soil Moisture system starting. Incoming Messages "new\_trigger", "filepath": "filedrop/run/2019031800/trigger\_201903180000.nc") arties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}}



{"name": "Manager", "description": "Manages simulation state and provides synchi

del] Generating trigger: trigger\_201903171800.d01.nc

dell Generating trigger: trigger 201903171200.d01.nc

|/3/1 12:4:53.403 [model] Generating trigger: trigger\_201903161800.d01.nc |/3/1 12:4:53.401 [model] Generating trigger: trigger\_201903161200.d01.nc

el] Generating trigger: trigger\_201903170600.d01.nc

'6 "Uploading level 3 fire imagery to Amazon S3 for distribution"

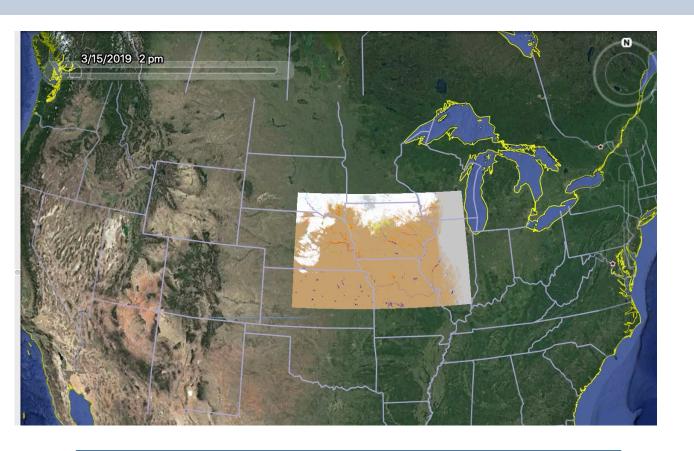
26 "L3: VIIRS Fire Imagery: Detected command SUCCESS, Return Code: 0" "Overlaying fires on image product" 97 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Proc 417 "All level 2 processing completed. Starting Level 3."

erties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"}} perties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}}

All Messages As Text (topic is #*)
2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"}
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new trigger", "filepath": "filedrop/baseline/20190316000t.nc"}
2021/3/1 15:28:46.144 {"name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/firef#", "nost/ground/#"], "type": "client"}}

### Downlink and Generate VIIRS Flood **Extent Product**

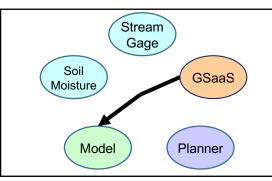




Downlink via AWS Ground Station Process flood product in the cloud

#### Simulation Time: 2019-03-15 18:00Z

12021/3/5 17:3:11:872 [CLOCK]: Received simulation time tick 2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019 2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: https: 2021/3/5 17:2:59.198 [SOIL] Sending soil moisture KMZ files. 2021/3/5 17:2:58.792 [CLOCK]: Received simulation time tick 2021/3/5 17:2:58.117 [NWIS]: Publishing Trigger Data for 2019 2021/3/5 17:2:47.727 [CLOCK]: Start of demo simulation. 2021/3/5 17:2:44.961 [SOIL] Soil Moisture system ready. 2021/3/5 17:2:44.823 [SOIL] starting...2 2021/3/5 17:2:44.283 [SOIL] starting...1 2021/3/5 17:2:43.921 [SOIL] starting...0 2021/3/5 17:2:43.427 [SOIL] Soil Moisture system starting... Incoming Messages



("message": "new\_trigger", "filepath": "filedrop/run/2019031900/trigger 201903190000.nc") {"message": "new trigger", "filepath": "filedrop/run/2019031800/trigger 201903180000.nc"} {"message": "new\_trigger", "filepath": "filedrop/run/2019031700/trigger\_201903170000.nc"}

1/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchro properties": ("simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00")} 1/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchroniz operties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}} GSaaS VIIRS Messages (topic is 'nost/GSaaS') 9 "Completed processing of the SDR VIIRS algorithm successfully 22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution" 3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"

ell Trigger file generation is complete el] Generating trigger: trigger\_201903171800.d01.nc 2021/3/1 12:4:53.407 [model] Generating trigger: trigger\_201903171200.d01.nc 2021/3/1 12:4:53.405 [model] Generating trigger: trigger\_201903170600.d01.nc del] Generating trigger: trigger\_201903170000.d01.nc odel] Generating trigger: trigger\_201903161800.d01.nc dell Generating trigger: trigger 201903161200.d01.nc

21/3/1 12:5:22.669 "Overlaving fires on image product" 1/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing. 1021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3." 1021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution Soil Moisture Messages (topic is 'nost/soilmoisture

21/3/1 12:5:31.12 ("taskingParameters": ("simStopTime": "2019-03-19T15:00:00+00:00")}
21/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchric

properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}}

NWIS Messages (topic is 'nwis/+'

All Messages As Text (topic is '#') {"message": "new\_file\_uploaded", "filepath": "files/swe\_output.nc"} idel]: Received new input, starting processing

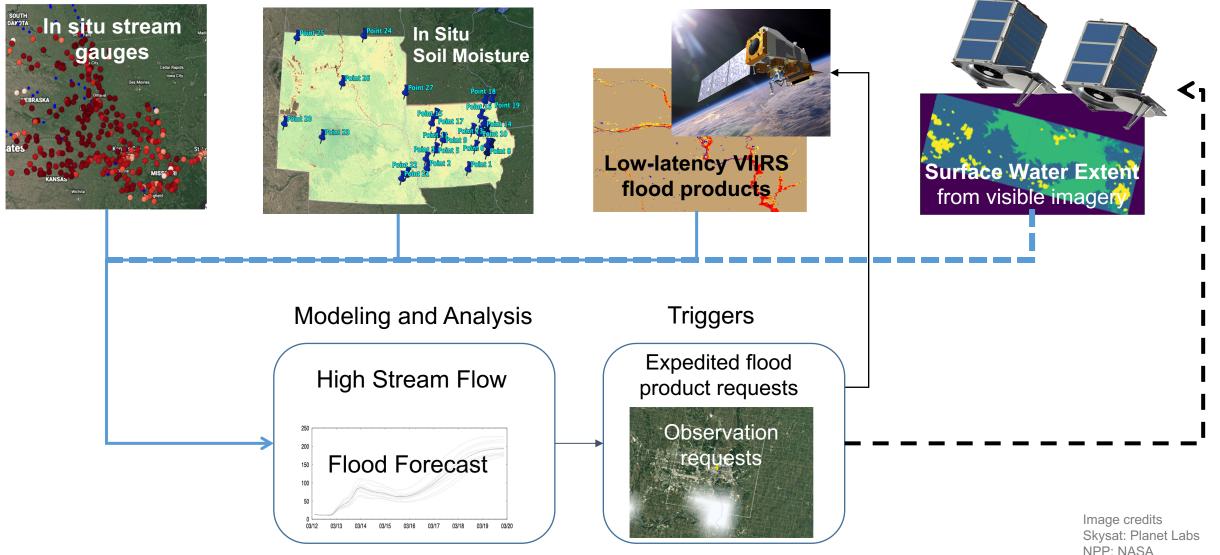
021/3/1 17:31:37.845 ("message": "new\_trigger", "filepath": "filedrop/baseline/2019031600/trigger\_201903160000.nc") 121/3/1 17:24:17.687 [model]: Received new input, starting processing

021/3/1 17:23:44.882 ("message": "new\_trigger", "filepath": "filedrop/baseline/2019031600/trigger\_201903160000.nc")

21/3/1 15:28:46.144 ("name"; "Scoreboard Node", "description"; "Displays a visualization of the simulation.", "properties"; ("resource"; "http://localhost:8050", "subscriptions"; ("nost/manager/#", "nost/frire/#", "nost/ground/#"), "type"; "client"

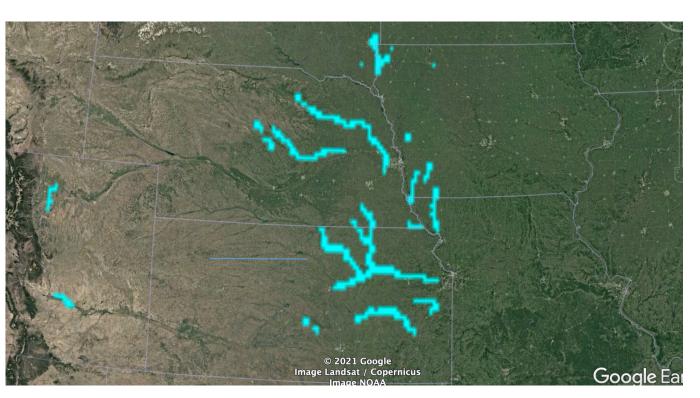
# New Observing Strategy for Flood Scenario





### Assimilate and Forecast: Flood "Triggers"

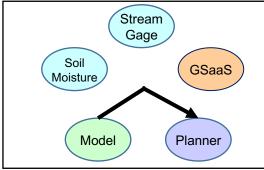




Forecast peak flows in 6-hour blocks

#### Simulation Time: 2019-03-16 00:00Z

2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Flot 2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL f 2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:3:41.574 [Gsas]: Sent VIIRS Flood File Notification 2021/3/5 17:3:41.567 [CLOCK]: Received simulation time tick, si 2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019-(2021/3/5 17:3:25.290 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:3:25.849 [Gsas]: Receiving VIIRS Direct Broadcas 2021/3/5 17:3:25.845 [GSas]: Receiving VIIRS Direct Broadcas 2021/3/5 17:3:25.845 [GSas] Tasking Amazon GS to receive ne 2021/3/5 17:3:25.847 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:3:12.847 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:3:12.847 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick, si 2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick, si 2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick, si 2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019-6



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properties", "(simTime", "2019-03-19706.00:00-00.00", "time", "2021-03-15716.04-59.876586+00.00"),
2021/31/124-04-47 (Tyane", "Manager, "description", "Manages simulation state and provides synchronized timing.",
properties", "(simTime", "2019-03-19700-00:00-00-00", "time", "2021-03-15716:04-45.477663+00:00"))

Gaas VIIRS Messages (topic is "nost/GSaaS")

2021/3/11/125-223-149 "Completed processing of the SDR VIIRS algorithm successfully!"

2021/3/11/125-228-78 "Uploading level 3 fire imagery to Amazon S3 for distribution"

2021/3/11/125-228-78 "La VIIRS Fire Imagery Detected command SUCCESS. Return Code: 0"

2021/3/11/125-225-591".3 VIIRS Fire Imagery Celeted command SUCCESS. Return Code: 0"

2021/3/11/125-225-591".3 VIIRS Fire Imagery Celeted command SUCCESS. Return Code: 0"

2021/3/11/125-25-591".3 VIIRS Fire Imagery Celeted command SUCCESS. Return Code: 0"

{"taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"}}

/3/1 12:5:18.830 ("name": "Manager", "description": "Manages simulation state and provides synch "("ginTime": "2019-03-1971:200:00+00:00", "lime": "2021-03-15716:05:14.676674+00:00") //3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchr

| 2021/3/11 124-53 4/0 | mode|| Trigger file generation is complete
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/17400, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/17200, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/17000, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/17000, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/17000, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/1600, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/1600, d/01.nc
| 2021/3/11 124-53 4/0 | mode|| Generating ringger, trigger, 2019/3/161200, d/01.nc

Soil Moisture Messages (topic is 'nost/soilmoisture/+')
Incoming Messages

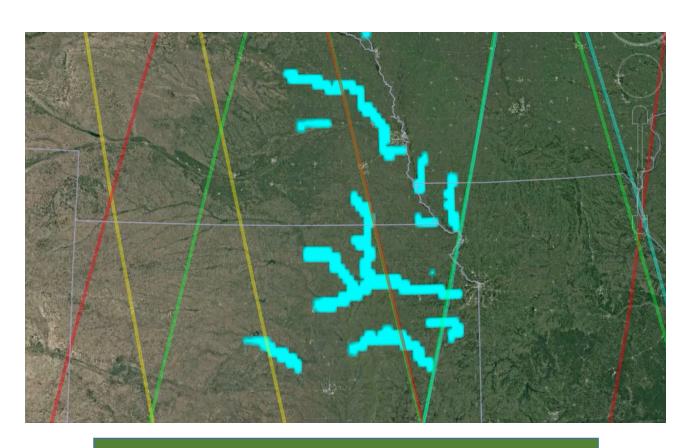
021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3." 021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution

All Massages & Tart (topic is '9")

20/3/11/39:27/583 ("message": "new file\_uploaded")
20/3/11/39:27/583 ("message": "new file\_uploaded", "fileplath": "files/swe\_output.nc")
20/3/11/39:28/44 ("message": "new file\_uploaded", "fileplath": "files/swe\_output.nc")
20/3/11/39:38/44 ("message": "new, urigger, "fileplath": "files/orbysealine/2019031600/trigger\_201903160000.nc")
20/3/11/39:47/47/7/68 ("message": new, urigger, "fileplath": "files/orbysealine/2019031600/trigger\_201903160000.nc")
20/3/11/39:47/48/48/2 ("message": new, urigger, "fileplath": "files/orbysealine/201903160000.nc")
20/3/11/39:48/48/2 ("message": new, urigger, "fileplath": "files/orbysealine/201903160000.nc")
20/3/11/39:48/48/2 ("message": new, urigger, "description": "files/orbysealine/201903160000.nc")

# Schedule Satellites to observe peaks

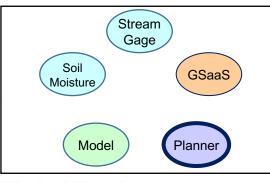




Schedule Satellites to image predicted peak flows

#### Simulation Time: 2019-03-16 06:00Z

2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and 2021/3/5 17:3:55.879 [SOIL] Download for day 16. URL: https: 2021/3/5 17:3:55.871 [SOIL] Sending soil moisture KMZ files. 2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick, 2021/3/5 17:3:55.867 [NWIS]: Publishing Trigger Data for 2018 (2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Flood: 17:3:43.4348 [MODEL]: Received VIIRS Flood File URI 2021/3/5 17:3:44.576 [SOIL] Waiting for hour 00. Current Time 2021/3/5 17:3:41.574 [GSaaS]: Sent VIIRS Flood File Notification 2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019 2021/3/5 17:3:27.290 [GSaaS]: Processing VIIRS Flood Produc 2021/3/5 17:3:27.290 [SOIL] Waiting for hour 00. Current Time 2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Direct Broadca 2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Plock Proceiving VIIRS Direct Broadca 2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Plock Proceiving VIIRS



## Retasking Messages (topic is "nost/planner") 2021/01/12-55-843 ("message": New\_trigger", "fliepath": "fliedropinun/2019031900/brigger\_201903190000.nc") 2021/01/12-85-843 ("message": New\_trigger", "fliepath": "fliedropinun/2019031900/brigger\_201903190000.nc") 2021/01/12-81-13-25 ("message": New\_trigger", "fliepath": "fliedropinun/2019031700/brigger\_201903170000.nc") 2021/01/12-21-13-86 ("message": "new\_trigger", "fliepath": "fliedropinun/2019031700/brigger\_201903100000.nc") Incoming Messages

NOS-T Manager Messages (topic is "nost/manager/")

2021/01/12/33/12 (Tasking/arameters", "Emispor Jime", "2019-03-19715-00-00-00")

2021/01/12/33/12 (Tasking/arameters", "Emispor Jime", "2019-03-19715-00-00-00")

2021/01/12/33/33/12 (Tasking/arameters", "description", "Manages simulation state and provides synchronized timing," properties", "(simTime", "2019-03-19712-00-00-00"), "time", "2021-03-15716-05-14-876674-00-00")

2021/01/12/33/33/("name", "2019-03-19712-00-00-00", "time", "2021-03-15716-04-99-876588-00-00"))

2021/01/12/44-971/ "(name", "Manager," description", "Manages unitation state and provides synchronized timing, "properties", "(simTime", "2019-03-1970-00-00-00"), "time", "2021-03-15716-04-45-77683+00-00"))

# Forecast (Model) Messages (topic is 'nost/model/#') [2027/81 124:58.3409 [model] Trigger file generation is complete [2027/81 124:58.3409 [model] Generating trigger; 201903171800.d01.nc [2027/81 124:58.3407 [model] Generating trigger; 2019031700.d01.nc [2027/81 124:58.3407 [model] Generating trigger; 1090317000.d01.nc [2027/81 124:58.3406 [model] Generating trigger; 1090317000.d01.nc [2027/81 124:58.3407 [model] Generating trigger; 1090317000.d01.nc [2027/81 124:58.3407 [model] Generating trigger; 1090317000.d01.nc [2027/81 124:58.3407 [model] Generating trigger; 1090316100.d01.nc

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

2021/3/1 125:23.149 'Completed processing of the SDR VIIRS algorithm successfully!'

2021/3/1 125:23.149 'Completed processing of the SDR VIIRS algorithm successfully!'

2021/3/1 125:22.287 13. VIIRS Fire Imagery Userbaced osmanad SUCCESS. Return Code: 0'

2021/3/1 125:22.287 13. VIIRS Fire Imagery Child job VIIRS Fire Imagery started. Processing.'

2021/3/1 125:22.287 13. VIIRS Fire Imagery Child job VIIRS Fire Imagery started. Processing.'

2021/3/1 125:22.287 13. VIIRS jet Processing completed. Starting Level 3.'

2021/3/1 125:22.281 'Uploading level 2 Flood, Fire and Polar/2Grid lies to Amazon S3 for distribution'

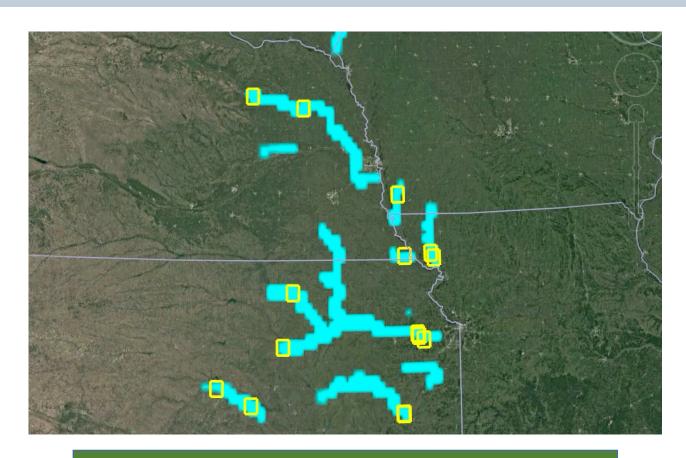
Soil Moisture Messages (topic is 'nost/soilmoisture/+')
ncoming Messages

#### All Messages As Text (topic is '#')

02/13/11/39/27/583 ("message": "new file\_uploaded")
02/13/11/39/27/583 ("message": "new file\_uploaded", "filepain": "files/swe\_output.nc")
02/13/11/39/28/14 ("message": "new file\_uploaded", "filepain": "files/swe\_output.nc")
02/13/11/39/28/48 ("message": "new fileger": files/swe=output.nc")
02/13/11/39/28/48 ("message": "new fileger", "filepain": "filedrophaseline/2019031600trigger\_20190316000n.c")
02/13/11/28/44/88/2 ("message": "new fileger", "filepain": "filedrophaseline/2019031600trigger\_20190316000n.c")
02/13/11/28/44/82 ("message": "new fileger", "filepain": "filedrophaseline/2019031600trigger\_20190316000n.c")
02/13/11/28/44/82 ("message": "new fileger", "filepain": "filedrophaseline/20190316000n.c")
02/13/11/28/44/8/mane": "Scoroboart Node", "description": "Displays a visualization of the simulation", "properties": "("resource": "http://localhost-8050", "subscriptions": "[nost/manager/#", "nost/fire/#", "nost/ground#"], "type": "client"]

## Satellite Images Acquired **Derive Surface Water Extent**

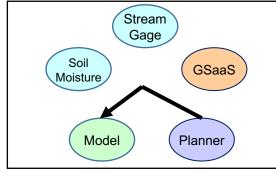




Schedule satellites to image predicted peak flows

#### Simulation Time: 2019-03-16 06:00Z

2021/3/5 17:4:12.339 [RETASK]: Received new input, starting 2021/3/5 17:4:12.339 [MODEL]: Sent 'new\_trigger' message to 2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed 2021/3/5 17:4:12.328 [SOIL] Waiting for hour 00. Current Time 2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, 2021/3/5 17:4:9.633 [NWIS]: Publishing Trigger Data for 2019 2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and 2021/3/5 17:3:55.879 [SOIL] Download for day 16. URL: https: 2021/3/5 17:3:55.871 [SOIL] Sending soil moisture KMZ files. 2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick 2021/3/5 17:3:55.857 [NWIS]: Publishing Trigger Data for 201 2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS F 2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URI 2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time 2021/2/5 17:2:41 574 [GGaaG]. Cant VIIDS Flood File Notificati



"message": "new\_trigger", "filepath": "filedrop/run/2019031800/trigger\_201903180000.nc"

1/3/1 12:5:3.835 {"name": "Manager", "description": "Manages simulation state and provides synchronic provides and provides synchronic provides and provides synchronic provides and provides synchronic provides and provides are provided by the provided provided by the provided provided by the provided properties": ("simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00")} /3/1 12:4:49.471 {"name": "Manager", "description": "Manages simulation state and provides synchronized timing perties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}} 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully 1/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution" 021/3/1 12:5:22.826 "L3; VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0" 021/3/1 12:5:22.669 "Overlaving fires on image product"

1.12 ("taskingParameters": ("simStopTime": "2019-03-19T15:00:00+00:00")}
8.630 ("name": "Manager", "description": "Manages simulation state and provides synchro

properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}}

021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing.

2021/3/1 12:5:22.417 \*All level 2 processing completed. Starting Level 3.\*
2021/3/1 12:5:22.291 \*Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution

Trigger file generation is complete Generating trigger: trigger\_201903171800.d01.nc del] Generating trigger: trigger\_201903171200.d01.nc del] Generating trigger: trigger\_201903170600.d01.nc del] Generating trigger: trigger\_201903170000.d01.nc del] Generating trigger: trigger\_201903161800.d01.nc dell Generating trigger; trigger 201903161200.d01.nc

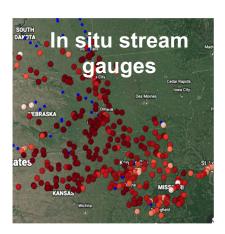
IWIS Messages (topic is 'nwis/+'

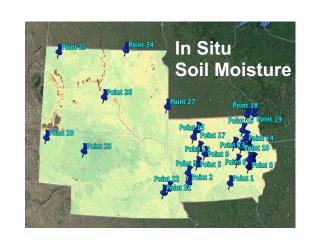
All Messages As Text (topic is '#')

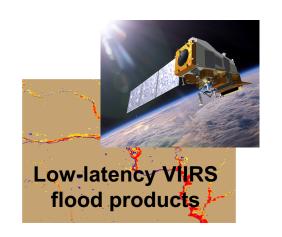
{"message": "new\_file\_uploaded", "filepath": "files/swe\_output.nc"} el]: Received new input, starting processing 021/3/1 17:31:37.845 ("message": "new\_trigger", "filepath": "filedrop/baseline/2019031600/trigger\_201903160000.nc") /3/1 17:24:17.687 [model]: Received new input, starting processing )21/3/1 17:23:44.882 ("message": "new\_trigger", "filepath": "filedrop/baseline/2019031600/trigger\_201903160000.nc"} 1/3/1 15:28:46.144 ("name"; "Scoreboard Node", "description"; "Displays a visualization of the simulation.", "properties"; ("resource"; "http://localhost:8050", "subscriptions"; ("nost/manager/#", "nost/manager/#", "nost/manager

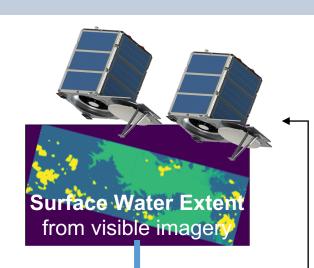
# New Observing Strategy for Flood Scenario











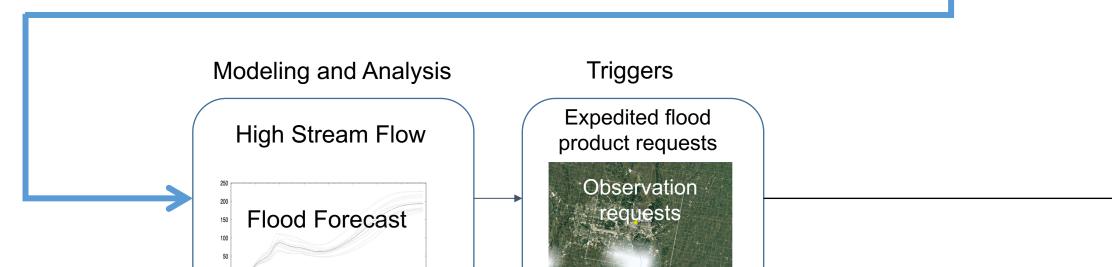
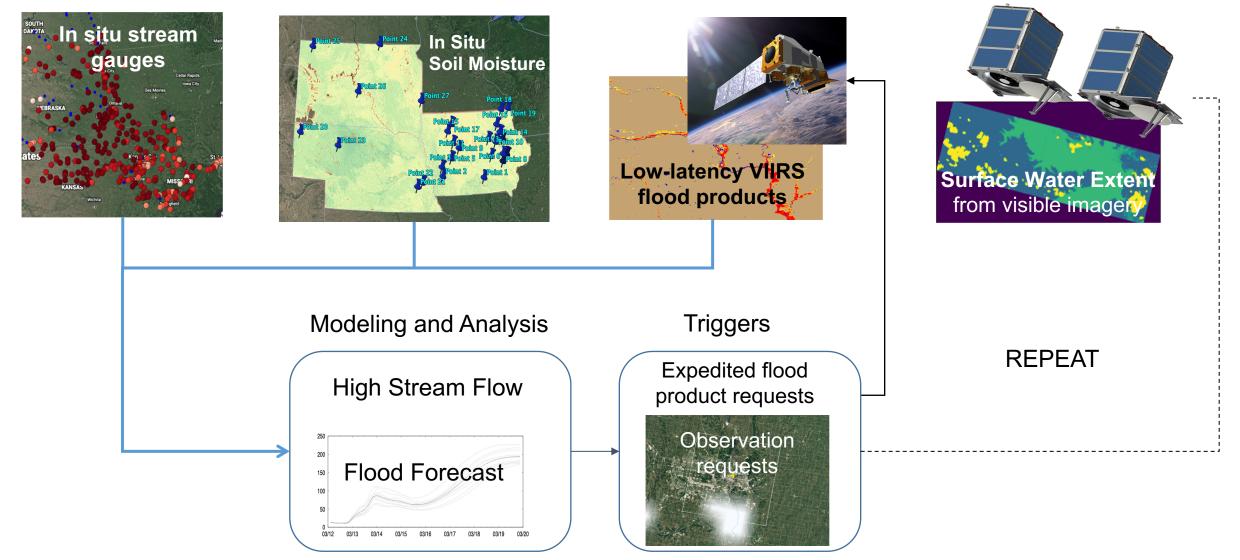


Image credits Skysat: Planet Labs NPP: NASA

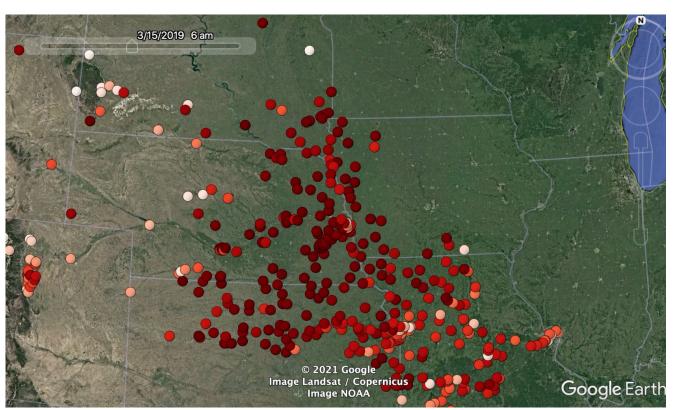
# New Observing Strategy for Flood Scenario





# **Stream Gauge Triggers**

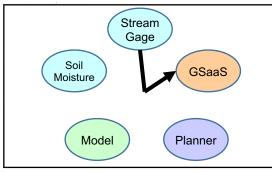




Detects unusually high flows

#### Simulation Time: 2019-03-16 06:00Z

2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time is: 2021/3/5 17:3:41.574 [GSaaS]: Sent VIIRS Flood File Notification I 2021/3/5 17:3:41.567 [CLOCK]: Received simulation time tick, sin 2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019-0: 2021/3/5 17:3:30.956 [GSaaS]: Processing VIIRS Flood Product C 2021/3/5 17:3:27.290 [SOIL] Waiting for hour 00. Current Time is: 2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Direct Broadcast. 2021/3/5 17:3:25.845 [GSaaS]: Tasking Amazon GS to receive new 2021/3/5 17:3:25.844 [CLOCK]: Received simulation time tick, sin 2021/3/5 17:3:25.847 [SOIL] Waiting for hour 00. Current Time is: 2021/3/5 17:3:11.867 [CLOCK]: Received simulation time tick, sin 2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019-0: 2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: https://sc



### Retasking Messages (topic is 'nost/planner') [2021/31 12:55:543 [message": 'new\_lrigger', "filepath": "filedrop/run/2019031900/trigger\_201903190000.nc") [2021/31 12:45:277 [message": 'new\_lrigger', "filepath": "filedrop/run/20190318000trigger\_201903180000.nc") [2021/31 12:31:1.125 [message": 'new\_lrigger', "filepath": "filedrop/run/2019031700/trigger\_20190317000.nc") [2021/31 12:31:356 [message": 'new\_lrigger', "filepath": "filedrop/run/20190316000/trigger\_201903160000.nc") [2021/31 12:31:356 [message]: 'new\_lrigger', "filepath": "filedrop/run/20190316000/trigger\_201903160000.nc")

NOS-T Manager Messages (topic is 'nost/manager/\*)

2021/3/1 125/3.112 ("tasking/parameters"; EmisOpt Time": "2019-03-19715-00-00+00-00")

2021/3/1 125-518.690 ("name": "Manager," description": "Manages simulation state and provides synchronized timing.", properties; "(simiTime": "2019-03-19716-00-00-00", "ime": "2021-03-15716-03-14.476674-00-00")

2021/3/1 125-3.355 ("name": "Manager," description": "Manages simulation state and provides synchronized timing.", properties; "(simiTime": "2019-03-19706-00-00-00", "ime": "2021-03-15716-03-9876568-00-00")

2021/3/1 124-49-471 ("name": "Manager," description": "Manages simulation state and provides synchronized timing.", properties: "(simiTime": "2019-03-19700-00-00-00", "ime": "2021-03-15716-04-45-477863-00-00"))

Properties: "(simiTime": "2019-03-19700-00-00-00-00", "ime": "2021-03-15716-04-45-477863-00-00"))

# Forecast (Model) Messages (topic is 'nostimodeli#') [2021/3/1124/53.409 [model] Trigger file generation is complete 2021/3/1124/53.409 [model] Generating trigger: trigger\_201903171800.d01.nc 2021/3/1124/53.409 [model] Generating trigger: trigger\_201903171200.d01.nc 2021/3/1124/53.405 [model] Generating trigger: trigger\_201903171200.d01.nc 2021/3/1124/53.409 [model] Generating trigger: trigger\_20190317000.d01.nc 2021/3/1124/53.401 [model] Generating trigger: trigger\_20190317600.d01.nc 2021/3/1124/53.401 [model] Generating trigger: trigger\_201903161800.d01.nc

CSaaS VIIRS Messages (topic is "nost/GSaaS")

2021/3/31/12/523.149 "Completed processing of the SDR VIIRS algorithm successfully!"

2021/3/31/12/523.249 "Uploading level 3 file imagery to Amazon S3 for distribution"

2021/3/31/52/52/38-01.3 VIIRS Frie Imagery. Detected command SUCCESS. Return Code: 0"

2021/3/31/52/52/38-0" "Cverlaying fires on image product"

2021/3/31/52/52/39 "Us VIIRS Frie Imagery. Child job VIIRS Fire Imagery started. Processing."

2021/3/31/52/52/39 "Us VIIRS Frie Imagery. Child job VIIRS Fire Imagery started. Processing."

2021/3/31/52/52/39 "Us VIIRS Frie Imagery. Child job VIIRS Fire Imagery started. Processing."

2021/3/31/52/52/39 "Us VIIRS Frie Imagery. Child job VIIRS Fire Imagery started. Processing."



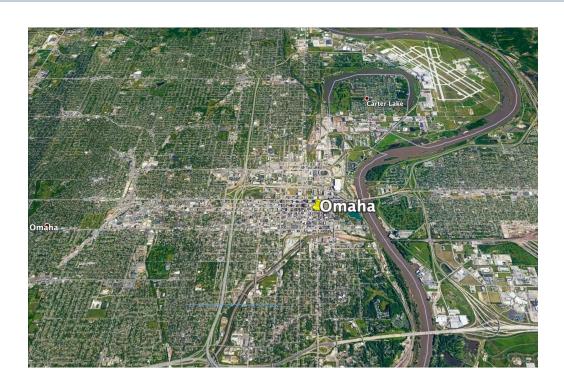
Soil Moisture Messages (topic is 'nost/soilmoisture/+') Incoming Messages

#### All Messages As Text (topic is '#')

1021/3/117:39:27.563 ["message", "new\_file\_uploaded"]
1021/3/117:39:21.611 ["message", "new\_file\_uploaded", "filepath"; "files/swe\_output.nc")
1021/3/117:39:21.611 ["message", "new\_file\_uploaded", "filepath"; "files/swe\_output.nc")
1021/3/117:31:37.845 ["message", "new\_fileger", "filepath"; "filedrop/baseline/201903160000.nc")
1021/3/117:2344.852 ["message", "new\_fileger", "filepath"; "filedrop/baseline/201903160000.nc")
1021/3/117:2344.882 ["message", "new\_fileger", "filepath"; "filedrop/baseline/201903160001trigger\_201903160000.nc")
1021/3/117:2344.882 ["message", "new\_fileger", "filepath"; "filedrop/baseline/201903160001trigger\_201903160000.nc")
1021/3/117:2344.882 ["message", "new\_fileger", "filepath", "filepath"; "filepath", filepath, "filepath", filepath, filepa

# Schedule AWS Ground Stations to receive next VIIRS direct broadcast

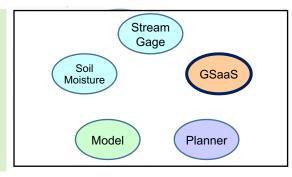




Schedule AWS Ground Station to receive NPP direct broadcast at 17Z

#### Simulation Time: 2019-03-16 12:00Z

2021/3/5 17:4:14.649 [RETASK]: Finished computation, Output 2021/3/5 17:4:12.339 [RETASK]: Received new input, starting pt 2021/3/5 17:4:12.339 [MODEL]: Sent 'new\_trigger' message to 2021/3/5 17:4:12.339 [MODEL]: Forecast Triggers completed a 2021/3/5 17:4:12.328 [SOIL] Waiting for hour 00. Current Time 2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, starting startin



### Retasking Messages (topic is 'nost/planner') 2027/31 12:55.843 ('message': 'new trigger', 'flepath': 'fledrophun/2019031900/trigger\_201903190000.nc') 2027/31 12:45.877 ('message': 'new trigger', 'flepath': 'fledrophun/2019031800/trigger\_201903180000.nc') 2027/31 12:311:125 ('message': 'new trigger', 'flepath': 'fledrophun/2019031700/trigger\_201903170000.nc') 2027/31 12:21:315 ('message': 'new trigger', 'flepath': 'fledrophun/2019031600/trigger\_201903160000.nc') Incoming Messages

NOS-T Manager Messages (topic is "nost/manager!")

20.21/3/11 225-3112 (Tasking/armeters", "Emispor Jime", "2019-03-19715-00:00+00:00")

20.21/3/11 25-318.203 (Traines", "Manager", "description." "Manages simulation state and provides synchronized timing." 
properties", "gimTime", "2019-03-19712-00:00+00:00", "time", "2021-03-15716-05-14.576674+00:00")

20.21/3/11 22-53.805 (Traine", "Manager", "description", "Manages simulation state and provides synchronized timing.", 
properties", "(simTime", "2019-03-1970-00:000-00:00", "time", "2021-03-15716-04-59.876688+00:00")

2021/3/11 24-49-471 (Traines", "Manager", "description", "Manages untulation state and provides synchronized timing." 
properties", "(simTime", "2019-03-1970-00:00+00:00", "time", "2021-03-15716-04-45.477863+00:00")

# Forecast (Model) Messages (topic is 'nost/model/ii') 2021/3/1 12-453-409 [model] Trigger file generation is complete 2021/3/1 12-453-408 [model] Generating trigger: 19903171800.d91.nc 2021/3/1 12-453-408 [model] Generating trigger: 19903171200.d91.nc 2021/3/1 12-453-408 [model] Generating trigger: 1990317000.d91.nc 2021/3/1 12-453-308 [model] Generating trigger: 19903170000.d91.nc 2021/3/1 12-453-308 [model] Generating trigger: 199031761800.d91.nc 2021/3/1 12-453-308 [model] Generating trigger: 199031761800.d91.nc

GSaaS VIIRS Messages (topic is "nost/GSaaS")

2021/3/11 125-23.149 "Completed processing of the SDR VIIRS algorithm successfully!"

2021/3/11 125-22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"

2021/3/11 125-22.867 33. VIIRS Fire imagery. Detected command SUCCESS. Return Code: 0"

2021/3/11 125-22.869 "Overlaying fires on image product

2021/3/11 125-22.897 13. VIIRS Fire imagery. Child by VIIRS Fire Imagery started. Processing."

2021/3/11 125-22.91 "Uploading level 2 Flood, Free and Polat/2/GM files to Amazon S3 for distribution"



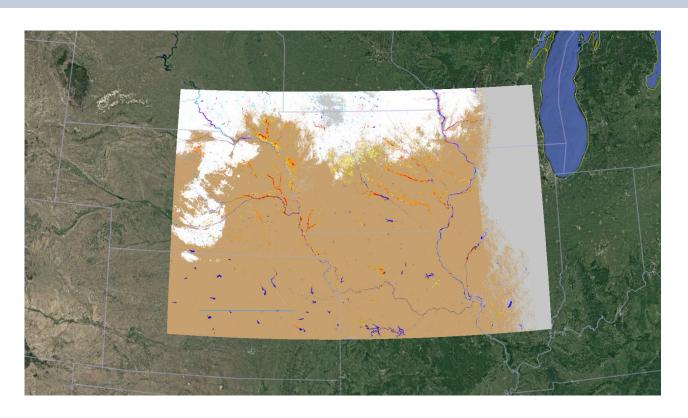
Soil Moisture Messages (topic is 'nost/soilmoisture/+')
Incoming Messages

#### All Messages As Text (topic is '#')

02//3/11/39/27/583 ("message": "new file\_uploaded")
02//3/11/39/27/583 ("message": "new file\_uploaded", "filepath": "files/swe\_output.nc")
02//3/11/39/28/44 ("message": "new file\_uploaded", "filepath": "files/swe\_output.nc")
02//3/11/31/38/894 (model): Received new input, starting processing
02//3/11/31/38/894 (model): Received new input, starting processing
02//3/11/24/17/687 [model]: Received new input, start

### **Next VIIRS Flood Extent Product**

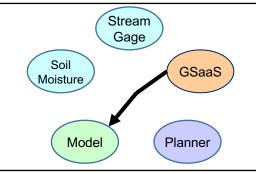




Downlink via AWS Ground Station Process flood product in the cloud

#### Simulation Time: 2019-03-16 17:00Z

2021/3/5 17:4:14.649 [RETASK]: Finished computation, Output no 2021/3/5 17:4:12.339 [RETASK]: Received new input, starting pro 2021/3/5 17:4:12.339 [MODEL]: Sent 'new\_trigger' message to Pla 2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed at 2 2021/3/5 17:4:12.328 [SOIL] Waiting for hour 00. Current Time is: 2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, sim 2021/3/5 17:4:9.633 [NWIS]: Publishing Trigger Data for 2019-03 2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and fo 2021/3/5 17:3:55.879 [SOIL] Download for day 16. URL: https://sc 2021/3/5 17:3:55.871 [SOIL] Sending soil moisture KMZ files. 2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick, sir 2021/3/5 17:3:55.867 [NWIS]: Publishing Trigger Data for 2019-0 2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Flood 2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL for 2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL for 2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time is:



Retasking Messages (topic is 'nost/planner')

2021/31 12:55.843 ('message': 'hew\_tigger', 'fliepath': 'fliedrophun/2019031900lhrigger\_201903190000.nc')

2021/31 12:36.277 ('message': 'hew\_tigger', 'fliepath': 'fliedrophun/2019031800lhrigger\_201903190000.nc')

2021/31 12:36.11:25 ('message': 'hew\_tigger', 'fliepath': 'fliedrophun/2019031700lhrigger\_201903170000.nc')

2021/31 12:36.56 ('message': 'hew\_tigger', 'fliepath': 'fliedrophun/2019031600lhrigger\_201903160000.nc')

Incoming Messages

D021G/H 12.5-18.50 (name\* "Manager," description\* "Manages simulation state and provides synchronized timing: properties", (FishiTime\*\* 2019-03-1917:20-00-000." time\*\* 202-03-16116:051-1676674-00:007).
D021G/H 12.5-3.835 (name\* "Manager," description\* "Manages simulation state and provides synchronized timing\*, properties", (FishiTime\*\* 2019-03-19160:00-00-000. "time\*\* 2021-03-161160-189-876589-00:007).
D021G/H 12.4-49.471 (name\* "Manager," description\* Manages simulation state and provides synchronized timing." properties\*; (FishiTime\*\* 2018-03-19100:00-00-000", "time\*\*: "2021-03-15716-09-45.477863-00:00")

2 {"taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"}}

# Forecast (Model) Messages (topic is 'nost/model/#') 2021/3/1124.53.409 [model] Trigger file generation is complete 2021/3/1124.53.408 [model] Generating trigger 201903171800.d01.nc 2021/3/1124.53.408 [model] Generating trigger 201903171200.d01.nc 2021/3/1124.53.405 [model] Generating trigger 201903171200.d01.nc 2021/3/1124.53.405 [model] Generating trigger 201903170000.d01.nc 2021/3/1124.53.403 [model] Generating trigger 201903170000.d01.nc 2021/3/1124.53.401 [model] Generating trigger 201903170000.d01.nc

QSaaS VIRS Messages (topic is 'nost/GSaaS')
2021/3/1 12:523.149 "Completed processing of the SDR VIRS algorithm successfully!"
2021/3/1 12:522.087 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:522.288 "L3: VIRS Fire imagery. Detected command SUCCESS. Return Code: 0"
2021/3/1 12:522.888 "Q-Vertalying fires on image product."
2021/3/1 12:522.589" "L3: VIRS Fire imagery. Child job VIRS Fire Imagery started. Processing."
2021/3/1 12:522.497 "L3: VIRS elevel 2 processing completed. Starting Level 3."
2021/3/1 12:522.291 "Uploading level 2 Flood, Fire and Polar/2Grid files to Amazon S3 for distribution"

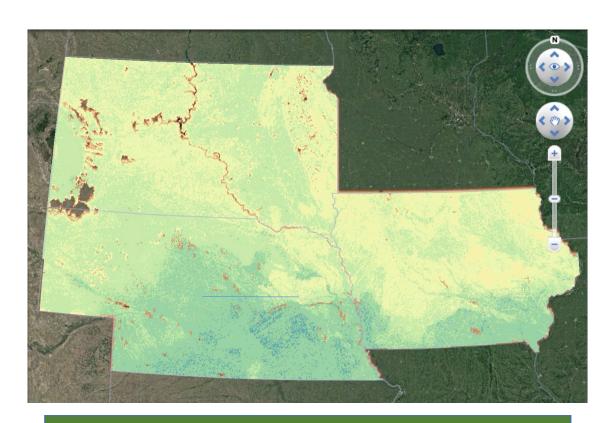
Soil Moisture Messages (topic is 'nost/soilmoisture/+')
Incoming Messages

#### All Messages As Text (topic is '#')

2021/31 fr.3:927.653 ("message": "new, file\_uploaded"). "filepath": "files/swe\_output.nc")
2021/31 fr.3:921.641 ("message": "new, file\_uploaded", "filepath": "files/swe\_output.nc")
2021/31 fr.3:3:3.894 [model]: Received new input, starting processing
2021/31 fr.3:3:3.894 [model]: Received new input, starting processing
2021/31 fr.3:3:3.845 [message": "new trigger." filepath": "filedroploaseline/20190316000trigger\_20190316000tri

## **Next Upscaled Soil Moisture**

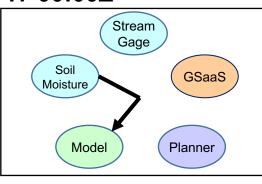




Generate upscaled soil-moisture product from in-situ network

#### Simulation Time: 2019-03-17 00:00Z

2021/3/5 17:4:37.882 [GSaaS]: Sent VIIRS Flood File Notification Me: 2021/3/5 17:4:37.872 [CLOCK]: Received simulation time tick, simula 2021/3/5 17:4:37.869 [NWIS]: Publishing Trigger Data for 2019-03-1 2021/3/5 17:4:29.886 [GSaaS]: Processing VIIRS Flood Product Com 2021/3/5 17:4:23.881 [GSaaS]: Receiving VIIRS Direct Broadcast. 2021/3/5 17:4:23.881 [GSaaS] Receiving VIIRS Direct Broadcast. 2021/3/5 17:4:23.881 [GSaaS] Tasking Amazon GS to receive next VI 2021/3/5 17:4:23.877 [CLOCK]: Received simulation time tick, simula 2021/3/5 17:4:23.869 [NWIS]: Publishing Trigger Data for 2019-03-1 2021/3/5 17:4:12.339 [RETASK]: Finished computation, Output new 12021/3/5 17:4:12.339 [MODEL]: Sent 'new\_trigger' message to Plann 2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed at 2013 2021/3/5 17:4:12.338 [SOIL] Waiting for hour 00. Current Time is: 06 2021/3/5 17:4:12.388 [CLOCK]: Received simulation time tick, simulation time tick,



### Retasking Messages (topic is "nost/planner") [2013/11/25-5.843 ("message": "new\_trigger", "filepath": "filedrop/run/20190319001rigger\_20190319000.nc") [2013/11/25-5.843 ("message": "new\_trigger", "filepath": "filedrop/run/20190318000trigger\_201903180000.nc") [2013/11/25-11.125 ("message": "new\_trigger", "filepath": "filedrop/run/20190317001rigger\_201903170000.nc") [2013/11/25-13.65 ("message": "new\_trigger", "filepath": "filedrop/run/201903160001rigger\_201903160000.nc") [2013/11/25-13.65 ("message": "new\_trigger", "filepath": "filedrop/run/201903160001rigger\_201903160000.nc")

00.nc")

2021/3/112.6331.2 ("taskingParameters": ("simStopTime": "2019-03-19T15-00:00+00:00"))

2021/3/112.618.630 ("name": "Manager": "description": "Manages simulation state and provides synchronized timing." properties." ("simTime": "2019-03-19T10:00:00-00"). "Itime": "2019-03-15T16:06-14-67674-40:00"))

2021/3/112.63.835 ("name": "Manager": "description": "Manages simulation state and provides synchronized timing.", properties." ("simTime": "2019-03-19T06:00:00-00:00", "time": "2019-03-15T16:06-98-876684-00:00"))

2021/3/112.44.94.71 ("name": "Manager": "description": "Manages simulation state and provides synchronized timing." properties." ("simTime": "2019-03-19T00:00:00-00:00", "time": "2021-03-15T16:04-45.477863+00:00"))

GSasS VIRS Messages (topic is "nost/GSasS")

# Forecast (Model) Messages (topic is 'nost/modell#') 2021/3/11/24-53.40 [model] Trigger file generation is complete 2021/3/11/24-53.40 [model] Generating trigger. trigger\_201903171800.d01.nc 2021/3/11/24-53.40 [model] Generating trigger. trigger\_201903171200.d01.nc 2021/3/11/24-53.40 [model] Generating trigger. trigger\_201903171000.d01.nc 2021/3/11/24-53.40 [model] Generating trigger. trigger\_20190317000.d01.nc 2021/3/11/24-53.40 [model] Generating trigger. trigger\_20190316100.d01.nc 2021/3/11/24-53.40 [model] Generating trigger. trigger\_20190316100.d01.nc

GSasS VIIRS Messages (topic is "nest/GSas5")

5021/3/1 12:5:22.149 Completed processing of the SDR VIIRS algorithm successfully!

5021/3/1 12:5:22.149 Completed processing of the SDR VIIRS algorithm successfully!

5021/3/1 12:5:22.80 To Ventacing level 3 for imagery to Amazon S3 for distribution\*

5021/3/1 12:5:22.80 To Ventacing level 3 for imagery to Marzon S3 for distribution\*

5021/3/1 12:5:22.80 To Ventacing fires on imagery choice document SUCCESS. Return Code: 0\*

5021/3/1 12:5:22.80 To Ventacing fires on image product.



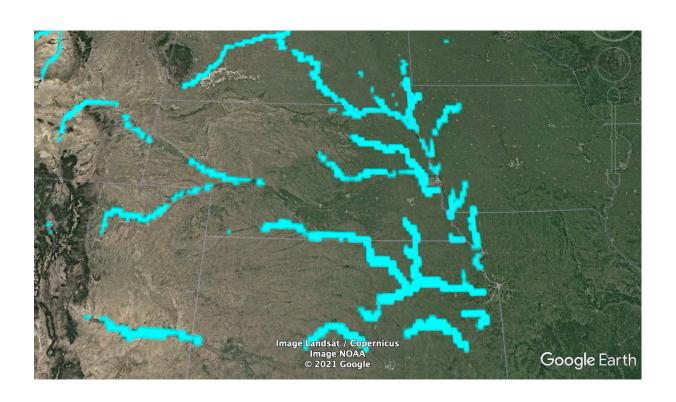
Soil Moisture Messages (topic is 'nost/soilmoisture/+')
Incoming Messages

#### All Messages As Text (topic is '#')

02/16/11/739/27.563 ("message": "new.file\_uploaded")
02/16/11/739/27.563 ("message": "new.file\_uploaded", "flepath": "flee/swe\_output.nd")
02/16/11/739/27.563 ("message": "new.file\_uploaded", "flepath": "flee/spie.eve.put.nd")
02/16/11/731/38.894 (model): Received new input, starting processing
02/16/11/731/38.894 (model): Received new input, starting processing
02/16/11/724/17.687 (mode

### **Assimilate Data and re-forecast**

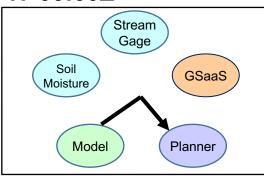




Assimilate and re-forecast Repeat workflow

#### Simulation Time: 2019-03-17 00:00Z

2021/3/5 17:4:55.299 [SOIL] Download for day 17. URL: https://s 2021/3/5 17:4:55.284 [SOIL] Sending soil moisture KMZ files. 2021/3/5 17:4:55.267 [CLOCK]: Received simulation time tick, si 2021/3/5 17:4:55.258 [NWIS]: Publishing Trigger Data for 2019-2021/3/5 17:4:40.557 [MODEL]: Finished downloading VIIRS Floc 2021/3/5 17:4:40.557 [MODEL]: Received VIIRS Flood File URL fi 2021/3/5 17:4:40.554 [SOIL] Waiting for hour 00. Current Time i 2021/3/5 17:4:37.882 [GSaaS]: Sent VIIRS Flood File Notification 2021/3/5 17:4:37.882 [GSaaS]: Processing VIIRS Flood Product 2021/3/5 17:4:27.88 [SOIL] Waiting for hour 00. Current Time is 2021/3/5 17:4:23.881 [GSaaS]: Received VIIRS Direct Broadcast 2021/3/5 17:4:23.881 [GSaaS]: Receiving VIIRS Direct Broadcast 2021/3/5 17:4:23.881 [GSaaS] Tasking Amazon GS to receive ne 2021/3/5 17:4:23.881 [GSaaS] Tasking Amazon GS to receive ne 2021/3/5 17:4:23.887 [GSaaS] Tasking Amazon GS to receive ne 2021/3/5 17:4:23.877 [CLOCK]: Received simulation time tick, si



## Retasking Messages (topic is 'nost/planner') [2021/31/12:55.843 (message': 'new\_trigger', 'fllepath': 'flledrophun/2019031900/trigger\_201903190000.nc') [2021/31/12:35.847 (message': 'new\_trigger', 'fllepath': 'flledrophun/2019031800/trigger\_201903180000.nc') [2021/31/12:311.125 (message': 'new\_trigger', 'fllepath': 'flledrophun/2019031700/trigger\_201903170000.nc') [2021/31/12:31.56 (message': 'new\_trigger', 'fllepath': 'flledrophun/2019031600/trigger\_201903160000.nc') [2021/31/12:31.56 (message': 'new\_trigger', 'fllepath': 'flledrophun/2019031600/trigger\_201903160000.nc')

| Model| Messages (topic is 'nost/model/#F) | GSasV VIRS Messages (topic is 'nost/model' is '

NWIS Messages (topic is 'nwis/+')
Incoming Messages

NOS-T Manager Messages (topic is 'nost/manageri+')

2021/31 12:53.13.2 (Tasking/armeters', 'Emissop Time', '2019-03-19T15.00.00+00.00')

2021/31 12:53.18.203 ('name', 'Manager', 'description', 'Manages simulation state and provides synchronized timing', 
'properties', '(marline', '2019-03-19T12.00:00-00', 'lime', '2021-03-15T16.05t4.8F6674-00.00'))

2021/31 12:33.38.5 ('name', 'Manager', 'description', 'Manages simulation state and provides synchronized timing', 
'properties', '(marline', '2019-03-19T06.00:00-00', 'lime', '2021-03-15T16.04-97686-00:00'))

2021/31 12:44.94.71 ('name', 'Manager', 'description', 'Manages simulation state and provides synchronized timing', 
'properties', '(marline', '2019-03-19T00.00:00-00', 'lime', '2021-03-15T16.04-45.477863+00.00'))

GSaaS VIRES Messages (topic is 'nost/GSaaS')

# CSaaS VIRS Messages (topic is 'nost/OSaaS') 2021/3/1128-223.149 "Completed processing of the SDR VIIRS algorithm successfully!" 2021/3/1128-223.787 Uploading level 3 fire imagery to Amazon S3 for distribution" 2021/3/1128-223.787 Uploading level 3 fire imagery Detected command SUCCESS. Return Code: 0" 2021/3/1128-223.783 VIRS Fire imagery. Detected command SUCCESS. Return Code: 0" 2021/3/1128-223.797 1.3 VIIRS Fire imagery. Critique job VIIRS Fire imagery started. Processing." 2021/3/1128-223.417 Viploading level 2 Frood, Fire and PolarZorfold files to Amazon S3 for distribution"



All Messages As Text (topic is '#')

2021/3/1 17:3927.593 ("message": "new file\_uploaded")

2021/3/1 17:3927.593 ("message": "new file\_uploaded", "filepath": "files/swe\_output.nc")

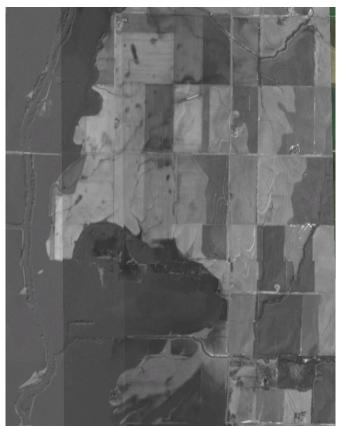
2021/3/1 17:393.884 [model]: Received new input, starting processing

2021/3/1 17:393.8854 [model]: Received new input, starting processing

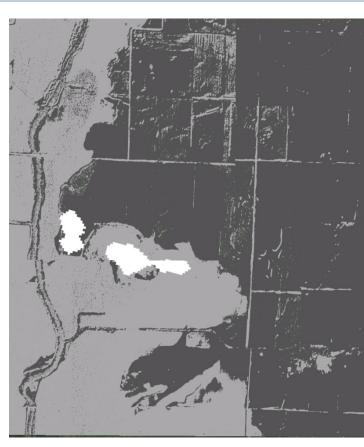
2021/3/1 17:393.7845 ["message": "new trigger": "new trigg

## **Enables Targeted images of flood peaks**





High resolution images of flood peaks



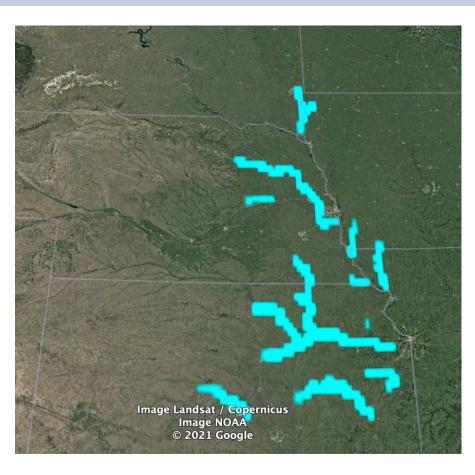
Surface water extent

- Model-driven dynamic retasking provides high resolution visible imagery of flood peaks as the flood is unfolding.
- Provides better resolution of flood plains and more precise surface water extent at those locations.

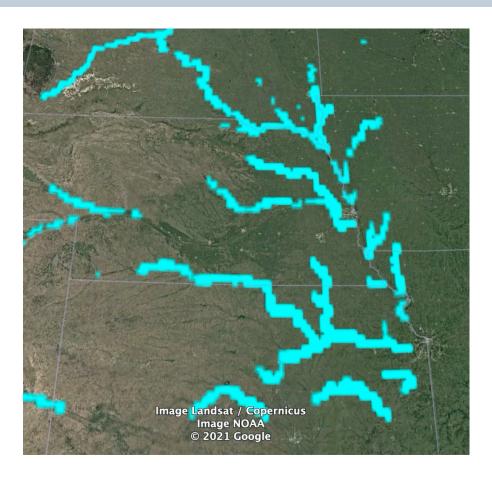
Dove images courtesy Planet Labs

## Model-directed data improves forecast





Triggers without directed observations

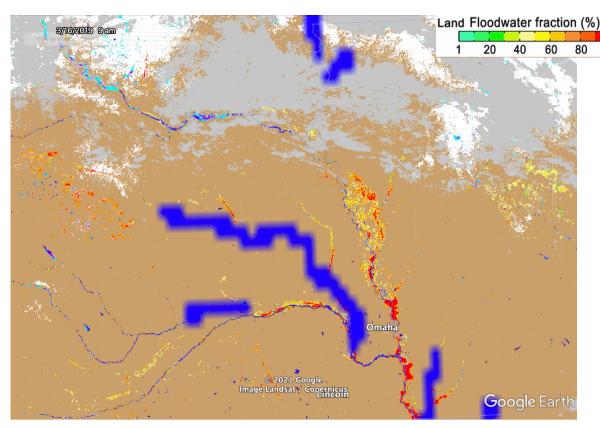


Triggers with directed observations

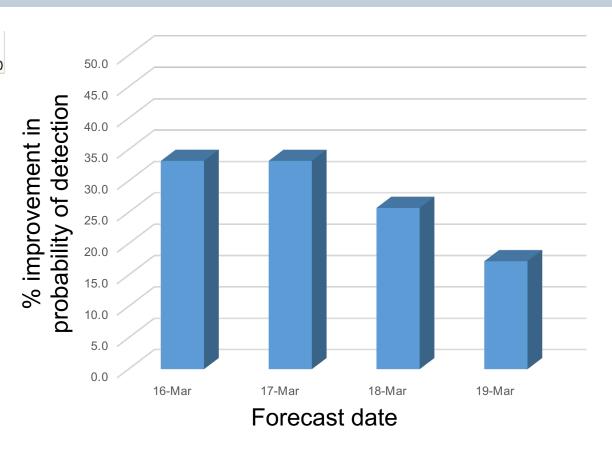
Forecast triggers include more flood areas after assimilating all directed observations

# NOS intelligent observing strategy improves model forecast





Red Dark blue Light blue ground truth (high confidence floods) forecast without assimilation forecast with NOS-directed observations



Forecast assimilating all NOS-directed observations (VIIRS, soil moisture, surface water extent) does ~30% better than same forecast without directed observations.

# Testbed provides environment for exploring NOS concepts



#### **Observing System**



Assimilation Smart Downlink Retasking



- First demonstration of a New Observing Strategy in the NOS Testbed
- Coordinates models, in situ, and remote sensing platforms to observe triggered and forecasted events.
- Future scenarios can consider other observing systems and science objectives

